Final Report

Shasta Weather Station

Submitted by:
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Submitted to:
US Fish and Wildlife Service
1829 So. Oregon St.
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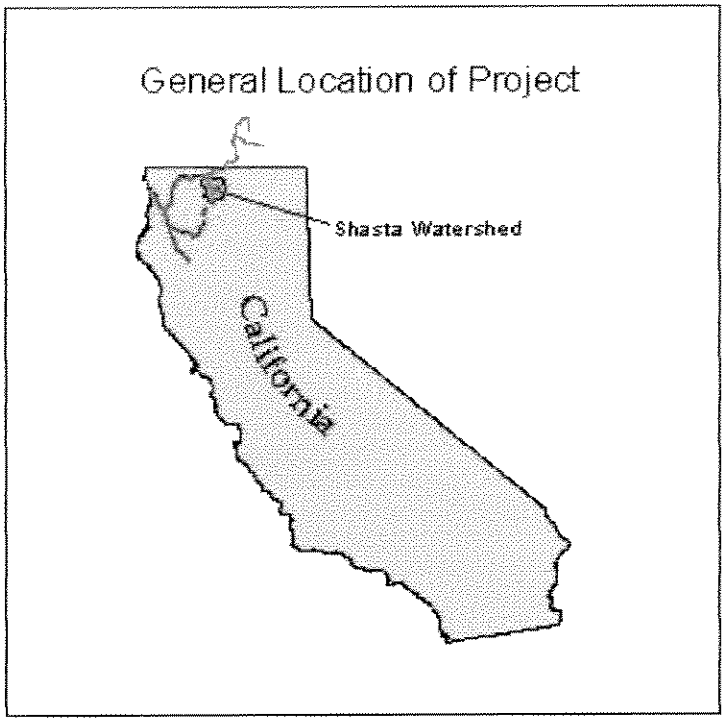
January 10, 2003

Cooperative Agreement # 14-48-11333-9-J040
Project Number 99-FP-10

Abstract:

The climate of the Shasta Valley is in many ways unique. Several fishery restoration efforts will benefit from access to climatological data generated within the Shasta Valley, including the development and improvement of a flow and temperature model for the Shasta River, and also efforts to fine-tune the application of irrigation water derived from the Shasta River. The Klamath River Basin Fishery Task Force and the US Fish and Wildlife Service have provided funds to allow the installation of a basic weather station in the Shasta Valley in close proximity to irrigated areas to provide necessary data. The station is located on the California Department of Fish and Game Shasta Valley Wildlife Area.

Description of Study Area:



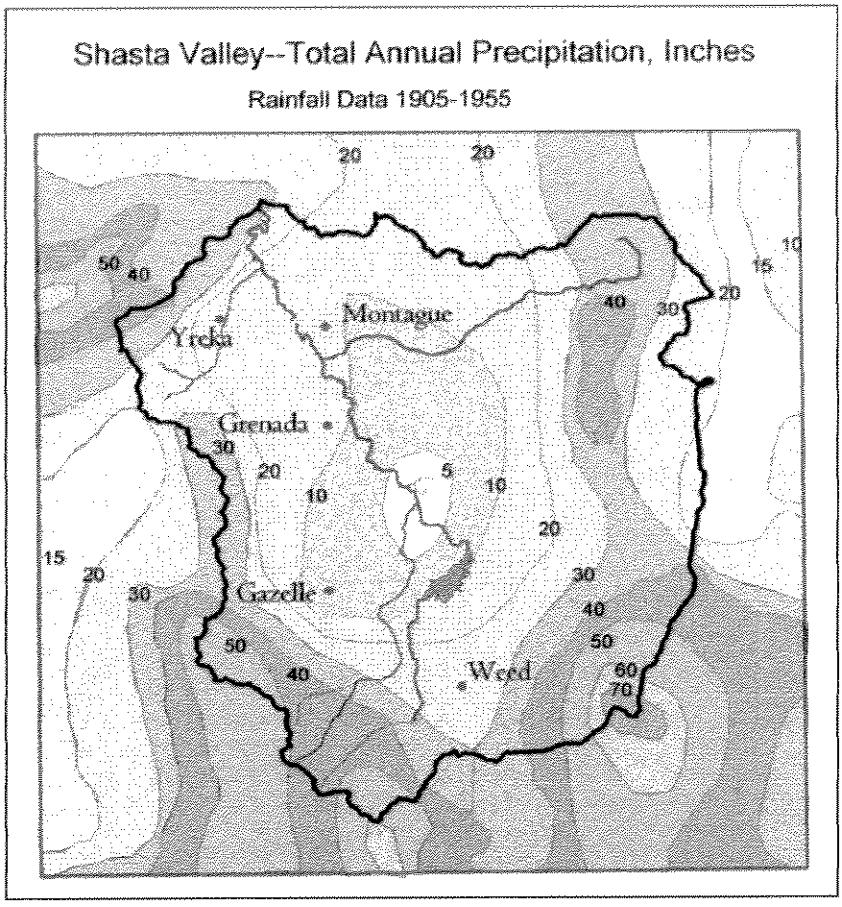
The Shasta River located in Siskiyou County, California flows out of the Eddy Mountains and Mount Shasta northward into the Klamath River approximately twenty miles south of the Oregon border, and 175 miles upstream form the Pacific Ocean. The Shasta Basin area is approximately 800 square miles with a mean annual unimpaired runoff of approximately 171,000 acre-feet. The mainstem Shasta River is approximately 60 miles long, with a permanent winter storage reservoir (Lake Shastina) at river mile 40. That reservoir limits the upstream range of salmon, and generally has no instream flow release other than to meet prior water rights immediately downstream of the reservoir.

Key features of the Shasta River include significant spring flow in the area below Lake Shastina, increased water development to provide water for irrigation in the middle portions of the Shasta Valley, river inflows and outflows of variable quantity and quality, both natural and irrigation derived, and a range of riparian conditions throughout the system.

Elevated water temperature and reduced dissolved oxygen levels have placed Shasta River on the California 303 (d) list of impaired waterbodies.

Anadromous fish using the system include fall Chinook salmon (Onchorynchus tshawytscha), coho salmon (Onchorynchus kisutch), and steelhead trout (Onchorynchus mykiss).

The climate of the Shasta Valley is extremely dry, with total precipitation ranging between 5 and 70 inches per year, depending on location. Temperatures on the valley floor range from below zero to over 100 degrees F.



Historically the Shasta River was the most productive salmon-bearing stream in the entire Klamath--Trinity Basin. Counts of Fall Chinook spawner returns begun in 1930 (after runs were described as insignificant in comparisons to their previous numbers) were as high as 81,000. The Shasta also produced high numbers of steelhead, and unknown numbers of Spring Chinook and coho. Spring Chinook are no longer found in the system.

Since the 1930's, Fall Chinook salmon numbers have dropped as low as 530 (in 1992), leading to concerns of extinction of the run, and precipitating the formation of the Shasta River Coordinated Resources Management and Planning (CRMP) group. By 1995, numbers had rebounded to as high as 13,000 demonstrating the continued resiliency of the Shasta system, and possible combined beneficial effects of restoration measures (including pulsed flows), and improved ocean conditions.

Introduction:

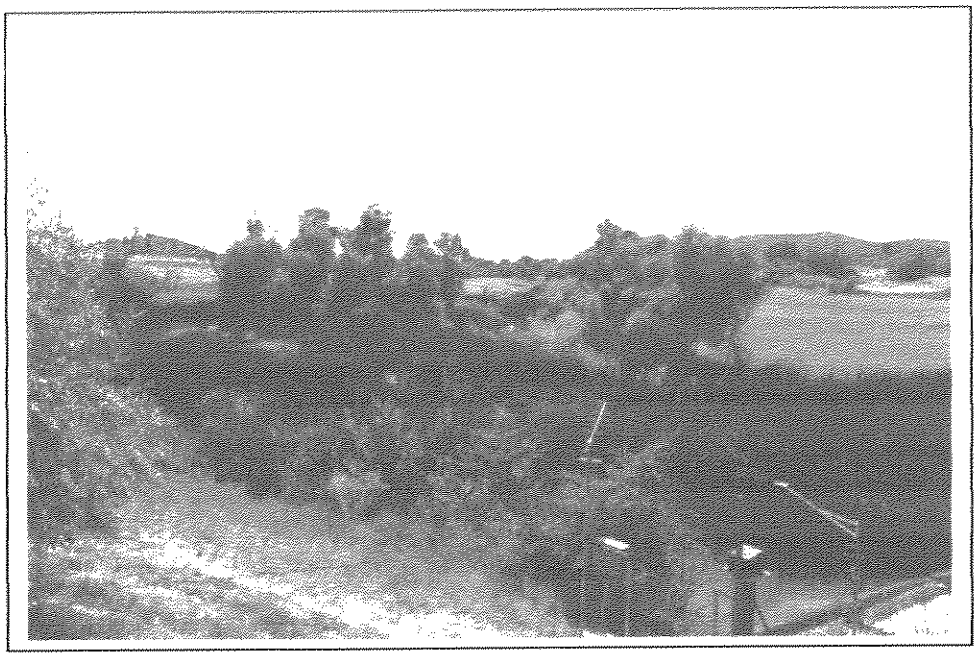
Prior to the 1950's there were several locations throughout the Shasta Valley that collected weather data (see attachment 1). Over time, interest and funding waned, until by the 1990s the only near-by weather data available was collected manually for fire fighting purposes near Yreka, and was not readily available electronically.

In the mid-1990's the Shasta (CRMP) and Shasta Valley RCD began work on a flow and temperature model for the Shasta River as a necessary tool to be used in developing and testing proposed restoration measures, and became aware of the need for accurate locally derived data for that purpose. Beyond that, the need to reduce irrigation water withdrawals and consequent irrigation tailwater return flows into the Shasta would also be furthered if irrigation could be moved towards a more scientific approach based on actual plant use and evaporation, rather than on best guess or other factors as is currently done.

The CRMP envisioned utilizing its existing data monitoring platform along the Shasta River south of Montague for the collection of some of the data, with the rest to be collected at a conventional weather station a few miles east of Montague on the Department of Fish and Game's Shasta Valley

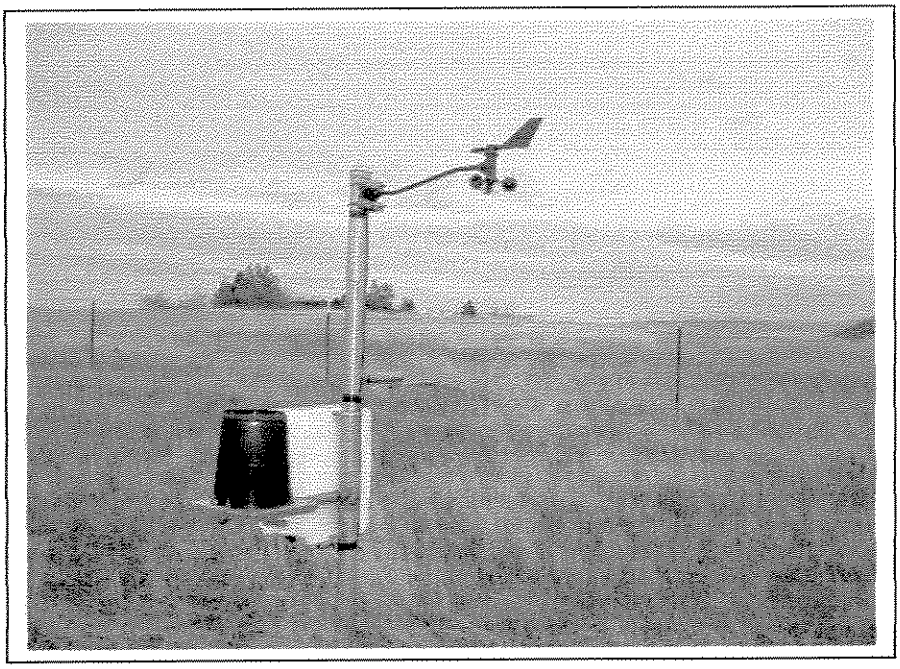
Wildlife Area. The initial installation south of Montague captured air temperature and solar intensity data—critical modeling parameters not available in the Shasta Valley, with wind, rainfall and humidity data capture coming later.

Methods and Materials:



Site of installation of solar intensity pyranometer and air temperature sensor just upstream of the Montague-Grenada Road Bridge over the Shasta River.

The existing CRMP monitoring station utilized a Campbell Scientific CR10 datalogger, solar panel and 12 volt battery, VS1 voice synthesizer, and a telephone modem, a combination that allowed both voice and computer communications for data transfer the system was installed in 1995. We added a Li-Cor LI-200SZ solar pyranometer and a Campbell 107B air temperature probe with passive shield to the existing array previously focused solely on instream parameters, and re-programmed the CR10 to collect store, average and summarize the data on an hourly basis. Data is downloaded periodically via computer and modem using a dedicated telephone line installed to the site. Instantaneous data can be captured either by computer connection, or by telephoning the station and then listening to a synthesized voice report of current readings. This system has performed without failure for 7 years, other than occasional loss of telephone line signal due to line failure elsewhere, and one instance of minor damage resulting from a



Weather Station installed at Shasta Valley Wildlife Area.

Informational board at Shasta Valley Wildlife Area describing local climatic conditions. Weather station is a few hundred yards to the north of this display.

lightning strike. Other data collected at the site includes water temperature, gage height, and conductivity.

The station installed at the Wildlife Area utilizes Davis Scientific weather station hardware with the addition of a custom fabricated fiber optic link to prevent lightening damage to the DFG computer equipment to which it is connected. Data captured includes rainfall, wind speed, wind direction, air temperature, and relative humidity. Evapo-transpiration is calculated from the above parameters. The weather station is located near DFG headquarters, and is connected by a buried data line and low voltage power supply line. DFG personnel monitor the station, and capture and store data.

Results and discussion of accomplishments:

Installation of the pyranometer and air temperature sensor was accomplished fairly easily, although it did require re-working the CR10 and VS1 programs (a somewhat painful process if not done regularly) to accommodate the additional sensors, changing the data storage frequency from every 15 minutes to every 60 minutes due to memory constraints, and jamming more wires and connectors into an already tight housing. Once installed, however, all components have performed without any real problems.

The Davis weather station hardware proved somewhat more problematic, with intermittent problems in some components eventually leading to over a year of temporary installation close to repair facilities to allow monitoring, replacement and burning-in of components to minimize likelihood of the need for field repairs. Additionally, custom fabricating the fiber optic link added complexity to the system and resulted in a component without documentation, making future repairs more difficult than is desirable. By the time the system was ready for final installation, infrared links were available that would have eliminated the fiber optic link and buried data communications cable. Money spent on the power cable and trenching would have then been better spent on a solar panel and battery, making installation much easier and probably cheaper and more reliable. Unfortunately, those coming technological changes were not apparent at the time the project was developed or begun.

Ultimately the combination of component problems, other more pressing time demands during good weather when installation was most reasonably accomplished, and difficulties coordinating schedules and site specific details led to significant delays in installation of the weather station on the Wildlife Area. While all of that was unfortunate, in the end it resulted in a reliable installation well integrated to existing site plans of the Wildlife Area, and in the care of personnel well equipped to keep it operational.

Data presently being collected includes: Solar intensity from 6/98 through the present (data collected every minute, then averaged hourly). Air Temperature from 6/98 through the present (also averaged hourly), plus absolute maximum and absolute minimum per day. Data to be collected at the DFG site will be wind speed and wind direction averaged hourly, precipitation totaled daily, and relative humidity measured hourly and air temperature measured hourly.

Shasta Weather Data summary statistics

Year	Max air F	date	Min Air F	date	Max Solar KW/Sq M	date
1998	107.5	9/1/98	no winter data		1.44	6/11/98
1999	103.6	7/11/99	15.7	12/28/99	1.443	6/1/99
2000	102.7	8/2/00	13.8	11/12/00	1.445	7/16/00
2001	102.2	8/8/01	13.5	2/28/01	1.367	6/1/01
2002	108.7	7/11/02	6.7	11/1/02	1.426	5/29/02

Summary and Conclusions:

In many cases, weather related data becomes most useful only once there is a long-term record from which to derive trends. That will no doubt be the case with this data, although it is already being used in the final development and calibration of the Flow and Temperature model for the Shasta River, and has also proven useful in interpreting changes observed in water temperatures on a short term basis.

Leaving the bulk of the equipment under the attention of the DFG will help to assure that it continues to operate over the long term, and that the data collected will be accessible to anyone needing it. Advances in data storage (ready access to cd writers) also will also to assure that data is preserved in the long run. It is also reasonable to expect that in the next year or two this data will probably be posted by the DFG as they develop a Wildlife Area web site. Integrating the weather data into day-to-day DFG operations that way will help assure that the needed data gathering functions will continue long after expiration of these grant funds.

Summary of Expenditures

U.S. Fish & Wildlife - P.O. Box 1006 - Yreka, CA 96097
USFW/Weather Station - 99-FP-10/14-48-113339-J040

3044

REPORT MONTH: Summary of Contract Expenses
CURRENT DATE:

	Contract Budget	Monthly Expenses	Cumulative Expenses	Contract Balance
Personnel Costs	$1,867.00	$0.00	$1,867.00	$0.00
Exp Eq/Mtrls	$4,585.00	$0.00	$4,585.00	$0.00
Operations/Maint	$465.00	$0.00	$465.00	$0.00
Travel	$234.00	$0.00	$234.00	$0.00
General Administration	$715.00	$0.00	$715.00	$0.00
Annual Totals	$7,866.00	$0.00	$7,866.00	$0.00
Contract Totals	$7,866.00		$7,866.00	$0.00
Billing Amount		**$0.00**		

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Paul F. Wagner, Ex.
Director

(I certify that above expenses were incurred for program.)

Matching Funds and In-Kind Services

Item	Match or In-Kind
Solar Radiation Sensor	260
Radiation Shield	65
Mounting post-build + materials	250
Wire Trenching labor	250
Installation 2 person days at $25.00/hr.	400
Misc. Repairs	400
Computer use,$200/yr for 5 yrs	1000
CR10 Datalogger and programming-Monitor Sta.	7200
CR10 maintenance and Data Collection, 5 yrs	4875
Monitor Station Phone line $15/mo. for 5 yrs.	900
Re-program CR10, 5 hrs @$25/hr	125
Install Pyranometer, 4 hrs @ $25/hr	100
Mileage	45
Subtotal	$15,870
Indirect match--Shasta Flow-Temperature Model	$140,000
Total Project match	$155,870

State of California

THE RESOURCES AGENCY

Department of Water Resources

BULLETIN No. 87

SHASTA VALLEY INVESTIGATION

JULY 1964

HUGO FISHER
Administrator
The Resources Agency

EDMUND G. BROWN
Governor
State of California

WILLIAM E. WARNE
Director
Department of Water Resources

State of California

TABLE 2

PRECIPITATION STATIONS IN AND ADJACENT TO SHASTA RIVER BASIN

Reference number (a) on Plate 3	Station	Elevation in feet	Period of record	(b) Source of record	Seasonal depth of precipitation 50-year mean 1905-1955, in inches	Recorded maximum and minimum Season	Inches
F3 0721	Betts Ranch	2,650	1944 - 1958	U.S.W.B.	14.38	1955-56 1954-55	22.52 7.08
F3 1997	Copco #1 Dam	2,700	1928 - 1952	O.A.E.S.	16.29	1937-38 1938-39	23.58 8.70
F2 2680	Edgewood	2,963	1888 - 1948	U.S.W.B.	20.24	1940-41 1938-39	39.12 9.15
F2 2899	Etna	2,950	1940 - 1958	Private U.S.F.S.	24.14	1955-56 1954-55	39.31 11.61
F2 3176	Fort Jones 6	3,400	1942 - 1958	U.S.W.B.	17.72	1955-56 1954-55	29.02 7.66
F2 3182	Fort Jones R.S.	2,747	1936 - 1958	U.S.W.B.	20.16	1957-58 1954-55	33.63 9.63
F2 3614	Greenview	2,818	1943 - 1958	U.S.W.B.	20.25	1955-56 1943-44	34.42 12.77
F2 3633	Grenada	2,560	1928 - 1930	Private	17.38	1926-27 1917-18	20.91 6.40
F3 3988	Hilt Slash Disposal	2,915	1933 - 1958	U.S.W.B.	20.20	1955-56 1954-55	35.93 9.41
F3 4105	Hornbrook	2,154	1888 - 1916	U.S.W.B.	13.42	1889-90 1912-13	25.65 6.85
F2 5785	Montague 3 N.E.	2,640	1948 - 1958	U.S.W.B.	10.33	1955-56 1954-55	17.48 4.89

TABLE 2 (continued)

PRECIPITATION STATIONS IN AND ADJACENT TO SHASTA RIVER BASIN

Reference number (a) on Plate 3	Station	Elevation in feet	Period of record	(b) Source of record	Seasonal depth of precipitation: 50-year mean 1905-1955, in inches	Recorded maximum and minimum: Season	Inches
F2 5783	Montague	2,517	1888 - 1948	U.S.W.B. D.W.R.	12.58	1889-90 1897-98	24.19 4.14
F2 5941	Mt. Hebron R. S.	4,250	1942 - 1958	U.S.W.B.	9.78	1957-58 1954-55	20.05 4.37
F3 6328	Oak Knoll R. S.	1,963	1942 - 1958	U.S.W.B.	21.50	1957-58 1954-55	37.73 11.01
F2 8025	Sawyers Bar R. S.	2,175	1933 - 1958	U.S.W.B. U.S.F.S.	42.44	1957-58 1954-55	73.51 24.17
F2 8050	Scott Bar	1,800	1922 - 1935	U.S.W.B.	26.67	1926-27 1923-24	49.18 15.04
	Siskiyou Summit	4,486	1899 - 1948	19U.S.W.B.	36.57	1920-21 1943-44	54.41 15.30
F2 8324	Soap Creek	3,500	1942 - 1947	U.S.W.B.	20.22	1942-43 1946-47	25.56 13.60
F2 9419	Walla Walla Creek	2,570	1853 - 1892	U.S.W.B.		1889-90 1874-75	49.97 12.72
F2 9866	Yreka	2,625	1871 - 1958	U.S.W.B. U.S.F.S.	17.32	1904-05 1954-55	31.29 7.08

(a) Employed by Department of Water Resources--Meteorologic Unit.
(b) U.S.F.S.-- United States Forest Service
U.S.W.B.-- United States Weather Bureau
O.A.E.S.-- Oregon Agricultural Experiment Station
D.W.R. -- Department of Water Resources